Release Notes for RELAP5-3D© Version 2.3
Improvements in Version 2.3

The following is a brief description of improvements and new features in version 2.3. Links to associated material in the User Manuals show as an underline.

ATHENA models included

This release of RELAP5-3D includes all of the features and models previously available only in the ATHENA version of the code. These include the addition of new working coolants, a magneto hydrodynamic model, and a user-defined gravitational constant that expands the capability of the code to model many more thermal-hydraulic systems. Added coolants are:

- Ammonia
- Carbon Dioxide
- Glycerin
- Helium
- Hydrogen
- Lead-Bismuth
- Lithium
- Lithium-Lead
- NaK
- Nitrogen
- Potassium
- Sodium

In addition to these working fluids, analysts can specify one or more noncondensable gases (argon, helium, hydrogen, nitrogen, xenon, krypton, air, sf6, oxygen, carbon dioxide, and carbon monoxide) as part of the coolant stream.

Working coolant improvements specifically intended for modeling supercritical fluids are available by invoking card 1 option 11.

Feedwater Heater Model

A new component model, FWHTR, has been added. This model was designed to enable the simulation of typical feedwater heaters found in nuclear power plants. A complete description of the model is in Volume I, page 3-380, and related changes are also found in Volume II, page 2-78 and Appendix A, page A7-49; Volume IV, pages 4-148 through 4-151; and Volume V, pages 4-30 through 4-33.

Radionuclide Transport Model

A new model has been added to permit the tracking of up to n species of radionuclides, as for example might occur when a fuel rod or rods become breached, releasing fission products into the coolant stream. See Volume I, pages 3-19 and 3-70; and Volume II Appendix A, pages A4-19 and A12-1.

BPLU is now the default solver

The default matrix solver was changed from the British linear equation solver, MA18, to the Border-Profile Lower Upper (BPLU) solver. BPLU is faster than MA18, generally produces more accurate answers, and RELAP5-3D often takes fewer advancements with BPLU than with MA18. For historical reasons, users can still access the MA18 solver by invoking card 1 option 35. Card 1 option 33 (used to invoke BPLU) has been made obsolete.

Neutron Kinetics

Several changes were made to the neutron kinetics:

- The xenon/samarium methodology was added to the cross-section option. See Volume II Appendix A, page A13-9.
- The Krylov solver for hexagonal geometry was added. See Volume II, Appendix A, pages A13-6, A13-10, and A13-17.
- Print control options for the nodal kinetics to suppress the axial and radial power distributions were changed, the actinide power was added to the power section of the major edit, and the settings for the print control options were included.

Time Step Repeat Logic Changed

Previously, RELAP5-3D would perform a “partial backup” under certain conditions occurring during a time advancement (velocity flip-flop, water packing, or noncondensable appearance). This partial backup prevented a repetition of certain computations that would not change on the next advancement (thus saving some computer time). However, it made the code more difficult to maintain. The occurrence of those conditions now requires a full backup to repeat the advancement. This change also added junction statistics blocks for velocity flip-flop and water packing and improved diagnostic edit header information.

Improved Pressurizer Model

Changes were made to the pressurizer model to improve its performance during insurges when sprays are activated. The user may optionally input the spray droplet size in the pressurizer component. The user may also optionally activate an enhanced interfacial condensation model in the pressurizer component. This capability models the mixing that occurs at the pool interface due to the impingement of the spray droplets on the stratified interface thereby bringing subcooled liquid to the surface causing enhanced condensation. See Volume I, pages 3-377 through 3-380; Volume II, page 2-77 and Appendix A, page A7-26; and Volume V, page 4-26.

Steady-State Option

Users can now “customize” the steady-state option (Word 2 on card 100) to enable or disable certain features. The new default mode when choosing “STY-ST” causes the following changes from a transient run:

- Suppression of CHF
- Suppression of trips
- Nearly-implicit solution scheme
- Bypass of mass error for time step control
- Semi-implicit coupling of heat structures and hydrodynamic volumes
- Suppression of auto termination at perceived steady-state

Each of these can be individually overridden. See Vol. II, Appendix A, page A2-18.

Thermal Stratification Model

Previously, the thermal stratification model only functioned with the semi-implicit solution scheme. It can now be invoked with the nearly-implicit solution scheme.

New User Options

Pump Model - Users can now the input the exponents for the pump friction torque model and the lower limit for the friction torque. See Volume II, Appendix A, page A7-94.

Minor Edits - Minor edit/plot variables were added for metal-water reaction model and counter-current flooding model. See Volume II, Appendix A, page A4-13 and page A4-10.

RELAP5-3D Code Corrections in Version 2.3

The following table describes significant corrections in version 2.3.

User Problem No.	Model/Feature	Problem Description	Correction
UP#03049	Kinetics	Table trip did not work for the control worth multiplier (even though Volume II, Appendix A of the manuals indicated it did).	Added the table trip capability to the table option for the control rod worth multiplier
UP#03054	Loss coefficients	The total user input loss coefficients ('fjunft' and 'fjunrt') were zero for all junctions, even though non-zero loss coefficients were input for some junctions.	In subroutine VEXPLT, add back in the missing lines that set the total user input loss coefficients ('fjunft' and 'fjunrt')
UP#04025	Cladding Rupture Model	Code failed following clad rupture	Flow area change corrected by weighting it by a factor and normalizing it by the sum of all factors for the hydro volume.